AIRPHOTO ANALYSIS IN LAND UTILIZATION RESEARCH

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Rapid progress in the application of airphoto analysis to assist in carrying out land utilization research has taken place in recent years. Use of airphoto interpretation to aid in the solution of the basic data problem was started in 1955 in the Farm Economics Division, Economic Research Service, U. S. Department of Agriculture. Since that time use of airphoto analysis has increased in the number of subject matter fields to which it has been applied and also in the development of methods to solve various types of problems. The purpose of this paper will be to review the problem, discuss briefly the subject matter fields, and describe the methods developed. Some of the material covered has been described in detail in separate papers over a period of time but it is hoped that this summary may be useful to those considering use of airphoto analysis in land utilization problems in Asia and the Far East.

The Basic Data Problem

Economic analysis in the field of land utilization depends upon many types of data which are lacking for many areas. Ideally an up-to-date map showing detailed land use, soil type, topography, and many other items would be the best source of data. However, for most areas this type of information is not available and for many studies sufficient time and money are not available to allow for field mapping.

In land utilization research there are three main areas where use of airphoto analysis is most appropriate as a source of basic data. The first area of application is in providing data on major uses of land either as compiled data measured from the airphoto or a map showing location and pattern of land use developed from study of airphotos. A second area is in the study of an area to isolate land use problem situations. For example, a large area can be covered to identify places where land is being cleared, urban development taking place and

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so on. Detailed study can then be concentrated on these areas of interest. The third major area where use of analysis can provide data is in the study of changes in use of land. Comparison studies of recent airphotos with earlier coverage can provide many kinds of data on changes and trends in land utilization.

Using airphoto analysis in the general areas described above has generally been limited to considering major uses of land or studies of items with distinctive characteristics that can be identified on 1:20,000 scale contact airphotos that are the most available for use. To provide more detailed information on such items as row crops or grains, large scale photographs taken at critical periods during the growing season would be needed.

Before describing the airphoto analysis methods developed to provide information, specific problem situations in the several subject matter fields where airphoto analysis has been used will be discussed briefly.

Subject Matter Fields for Airphoto Analysis

Airphoto analysis has been used in several subject matter fields in land utilization research. The data problem has varied considerably and is illustrated by the problem situations described below. In each of the situations airphoto analysis supplied acceptable data for economic analysis within the time and fund limitations imposed for the particular situation. The references cited describe the details of the procedure followed.

Floodplain delineation and land use

To study the economic effect of a flood control dam, it was necessary to delineate the boundary of the flood plain and measure the acreage of the different types of land use included. It was also necessary to determine the acreage and types of land use affected by different flood stages both for the natural conditions and those prevailing with a flood control dam in operation. 1/

Land development

The first use of airphoto comparison analysis in the Farm Economics Division was made in a study of the Coastal Plain in North Carolina. Forest land was being cleared and drained for cropland. Data were needed on the total acreage and type of forest land being cleared, to determine the significance of this development. Information was also needed on the location and size of tracts cleared so that these areas

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1/ Dill, H. W., Jr., Photo Interpretation in Flood Control Appraisal, Photogrammetric Engineering, Vol.21, No.1, 1955.

could be visited in the field to study types of equipment used, methods of carrying out work, and the costs and benefits of this type of land development. The study was made for two time periods since three airphoto coverages taken at intervals were available. 2/

Shifts in use of land

Data on changes in use of land were needed for large river basins where agricultural use was changing to urban use and for other areas where farmland was reverting through stages of idle and brushland to forest. 3/

Highway construction impact on use of land

A study of the "before and after" situation with reference to changes in land use taking place where major highways had been constructed, particularly on the area around interchanges.

Recreation site location

Data were needed on the number of potential recreation sites and the prospects for future hunting areas in the northeastern United States. Information was needed on the occurrence of several basic types of recreation sites.

For the above situations time and funds were limited and the methods described below were developed to provide the best data for economic analysis within the limitations for each problem.

Airphoto Analysis Procedures

The methods used to provide data from airphoto analysis include two basic approaches, direct identification from one coverage and comparison analysis using two or more successive coverages taken at intervals. Either of these approaches can be used in three different ways. These include stereo interpretation of contact prints, use of airphoto index sheets, or controlled mosaics and airphoto analysis of sample plots.

2/ Anderson, J. R. and Dill, H. W., Jr., Land Clearing and Drainage in Eastern North Carolina, U. S. Agr. Res. Serv., ARS 43-127, 1961.

3/ Dill, H. W., Jr., Use of the Comparison Method in Agricultural Airphoto Interpretation, Photogrammetric Engineering, Vol.25, No.1, 1959.

Direct identification

Our use of direct identification has ranged from studies to delineate flood plain limits to making counts of conventional items such as houses, barns, and mapping major land use to "best estimates" of less characteristic items. Such items would include land use-soil combinations, potential recreation pond sites, and other items where the only source of data is the airphoto.

Airphoto comparison analysis

For many problems data are needed on the amount and trend of changes in use of land. Where more than one airphoto coverage is available, changes in use can be identified by comparing successive coverages flown at intervals. Areas of change can be identified, located, measured, and studied in the field to provide data on costs, benefits, and so on.

Both basic approaches have been used on three different "scales" depending on the problem. We began our work by using stereo analysis of 1:20,000 contact prints to study flood plain areas. To determine land use changes, land clearing, and drainage, we used stereo analysis of 1:20,000 contact prints to study townships averaging about 50,000 acres. While we were able to provide useful data within a relatively short time and save money, there was still need for faster means of providing data for larger areas, such as counties, river basins, and other areas delineated for special study. Stereo analysis of contact prints, required placing match lines on each alternate print to avoid duplication or missing portions of the study area, both for the analysis and measurement of data.

Use of airphoto index sheets

To study larger areas we have used airphoto index sheets (1:63,360) to provide many types of data. While these are not controlled mosaics, they are readily available, very reasonable in cost, and after analysis has been completed provide a map for field study of changes identified. In some studies we have used photo index sheets to study large areas to locate "possible" areas of land use change to be studied in greater detail by larger scale stereo analysis. This procedure aids greatly in reducing the area of consideration and concentrates time and funds for purchase of larger scale airphotos on the areas of greatest interest.

Airphoto analysis of samples

A third method has been developed recently in which we use airphoto analysis on sample plots. Recently in the U. S. a national sample was designed for the U. S. Department of Agriculture for the National Inventory of Soil and Water Conservation Needs. 4/ Cooperative agreements

4/ Dill, H. W., Jr., and Nobe, K. C., New Resource Planning Data from the National Inventory of Conservation Needs. Journal Soil and Water Conservation Vol.15, No.5, 1960

were made by the Department with the Statistical Laboratory at Iowa State University, and the Biometrics Unit at Cornell Universoty to select a national sample of land use and soil conditions.

A basic area sampling rate of 2 percent was determined to be statistically reliable at the county level.

For most of the country the sample plot size was 160 acres, except for the 13 Northeastern States where a unit of 100 acres was used.

The sample plots were identified on individual county maps; the plot boundaries transferred to an airphoto base for field mapping and measuring of data. In the field, Soil Conservation Service technicians mapped cropland, pasture and range, forest and woodland, other land (farmsteads, idle agricultural land, wildlife areas and other nonagricultural use), and urban use. In addition, the soil type, percentage of slope, and degree of erosion were carefully mapped and annotated on the airphoto by appropriate symbols. The field data were measured and tabulated to show the acreage of each combination of land use with soil type, slope and erosion, and the land use capability class in which this combination would be included. A separate plot summary was prepared for each sample and the data expanded to prepare county estimates and then combined into estimates for each State. For the most part, the computing was carried out by using punch cards prepared from the summary sheets, and rapid data machine processing. These data are unique because for the first time land use information in combination with soil and other information are available on a uniform basis for the whole country. The data can be assembled to make estimates for any area by selecting and summarizing the sample plots included.

In addition to making compilations of the data, however, the sample plots themselves provide a statistical sample already drawn for making many types of studies by means of airphoto analysis. In a project recently completed, airphoto analysis was used of the sample plots to determine the potential for recreation sites and hunting areas for the Northeastern United States. In the time available it was impossible to study the entire sample (about 18,000) plots so a random sub-sample of 4,500 were drawn for airphoto analysis. The plots were examined to identify five basic types of recreation sites and each sample plot classified as to its wildlife habitat class that would support game species of different kinds. Data on the number of potential sites, as determined by airphoto analysis, were applied to the total acreage of forest, idle, or pasture land in the sample universe to compute the rate at which the potential sites occurred. For example, we found that at least 1 in 5 basic types of site occurred for each 129 acres of forest.

Using airphoto analysis with this sample enabled us to make this estimate for 10 States in the year available for the study. Even with use of a sample we found that handling and accounting for a large number of

plots presented a problem. The original operation plan was to borrow copies of the sample plots on airphotos from county field offices and return them after the recreation study had been completed. We soon realized that copies of the sample plots would be useful for other studies, and that microfilming was the most economical way to copy and retain the material. The county sample location maps were copies on 35 mm. microfilm and for the sample field plots and summary sheets 16 mm. microfilm was used. We now have a convenient file of 400 county maps and 18,000 sample plots for the Northeastern United States for use in future research studies.

Conclusion

Use of airphoto analysis in land utilization research has provided acceptable data for economic analysis within time limitations imposed and with minimum expense. The three methods developed present a choice of procedure in using airphoto analysis depending on problem requirements. When appropriate they can be used singly or in combination as a substitute for field mapping, particularly where data are needed for large areas. Airphoto analysis is not a substitute for detailed field study, but we are getting suitable data in a relatively short time, at low cost, and with a minimum number of experienced workers.